NEWSLETTER

VOLUME 16 NUMBER 2 SPRING 1978

REGISTERED FOR POSTING AS
PUBLICATION (CATEGORY B)

AUSTRALIAN SOCIETY FOR LIMNOLOGY

NEWSLETTER

VOLUME 16 NUMBER 2 SPRING 1978

CONTENTS

NEWS AND ANNOUNCEMENTS	1- 4
CONFERENCES	5- 7
RESEARCH ACTIVITIES	8-10
ABSTRACTS OF THESES	11-13
A.S.L. BUSINESS	14-16
BOOK REVIEWS	16-23
AN ESSAY	24-28

THE AUSTRALIAN SOCIETY FOR LIMNOLOGY

The Australian Society for Limnology is an association of over 300 people with professional or amateur interests relating to Australian inland waters. Since its inception in 1961 the Society has played an important role in fostering limnological work in this country. The ASL promotes liaison between limnologists in academic, private and governmental institutions, and has a vested interest in the conservation of aquatic and related resources. Annual congresses are held near centres of limnological interest, and the programme includes scientific sessions, field excursions, and social activities.

The ASL produces a Newsletter, with notes on activities, articles of general interest, book reviews, and congress announcements, and an occasional Special Publication. A further periodical publication is the Directory of Australian Limnologists.

Membership applications are welcomed; four classes of subscribing membership are catered for:

- Ordinary members ($8.00 p.a.)
- Student members ($4.00 p.a.)
- Institutional members ($5.00 p.a.)
- Sustaining members ($50 p.a. or more)
- Affiliated bodies (subs on application)

NOTE: Members are entitled to receive the Aust. J. Mar. Freshwat. Res. at a reduced rate ($7.50).

Subscriptions cover the period 1 July-30 June.

Details are available from:

I. Campbell Esq.
Hon. Sec./Treasurer, A.S.L.,
Department of Chemistry
Caulfield Institute of Technology
P.O. Box 197
Caulfield East, Victoria 3145

+ + + + + + + + + + + + + + +

Newsletter contributions are always welcome, and correspondence should be addressed to the Newsletter editor. The deadline for the next issue is 1 March 1979.

ASL EXECUTIVE 1978-1979

President:

Dr I.A.E. Bayly

Vice President:

Dr B.T. Hart

Secretary/Treasurer:

Mr I. Campbell

Committee:

Mr J. Bell
Mr J. Blyth
Ms A. Fletcher
Mr B. Harasymiw
Dr P.S. Lake
Dr L. Llewellyn
Mr B. Mitchell
Ms J. Powling

Newsletter editor:

Dr P.S. Lake
Department of Zoology
Monash University
Clayton
Victoria 3168

NEWS AND ANNOUNCEMENTS

MATERIAL FOR THE NEWSLETTER

Members should note that the success of the Newsletter depends on the supply of material to the editor. Members of A.S.L. are urged to send to the editor any items they deem suitable for publication in the Newsletter. If there is any doubt as to the suitability of any item, please forward the item and let the editor decide. Items sought from members for the Newsletter include:

News = tidings, fresh events reported
Brief summaries of limnological activities
Announcements of conferences
Reports of meetings, seminars, conferences or committees
Book reviews
Announcements of publications
Requests for limnological data, biological material or limnological assistance
..... etc.

AUSTRALIAN SOCIETY FOR LIMNOLOGY - ANNUAL CONFERENCE 1979

The annual conference of the Australian Society for Limnology will be held at Tallangatta, Victoria, from 18-21 May 1979. The venue of the conference is a compact town by the shores of Lake Hume. Motel and hotel accommodation has been booked and excellent camping and caravan facilities are available. The business of the conference will take place in the newly completed Tallangatta Sports Centre. The scientific business of the conference will be in two parts; one part devoted to the presentation of general papers and the other devoted to a symposium on the management of impounded waters (dammed waters). For Sunday afternoon a barbecuing excursion to Dartmouth Dam is planned. Further details will be given in the next Newsletter.

C.S.I.R.O./ACADEMY OF SCIENCE: Joint review of Australian journals of scientific research

The C.S.I.R.O. and the Academy of Science have set up a small joint committee to undertake a review of the following journals:

Australian Journal of Agricultural Research
Australian Journal of Biological Sciences
Australian Journal of Botany
Australian Journal of Chemistry
Australian Journal of Marine and Freshwater Research
Australian Journal of Physics
Australian Journal of Plant Physiology
Australian Journal of Soil Research
Australian Journal of Zoology

The review will be looking at such questions as: (a) the need for and the role of these journals in relation to Australian scientific publishing needs; (b) the part that they play in relation to world scientific publications; and (c) the scientific quality and impact of the papers they publish.

/Interested

Interested scientists are asked to give their views on the journals, paying particular attention to the three questions listed above, but in no sense should they feel constrained by these.

Comments should be sent to:

Review of Journals
The Secretary
C.S.I.R.O.
P.O. Box 225
Dickson, A.C.T. 2602

UNITED STATES ENVIRONMENT PROTECTION AGENCY - WATER QUALITY CONTROL TRAINING COURSES

For Australian limnologists this item will no doubt arouse envious cravings. The U.S. Environmental Protection Agency from October 1978 to September 1979 will be running the following courses:

Water Pollution Control
- Wastewater treatment (technology)
  - 162.2 Biological treatment technology
  - 166 Sludge treatment and disposal
  - 173 Orientation to municipal wastewater treatment
  - 177 Land application of wastes
- Wastewater treatment (evaluation and inspection)
  - 163 Operational considerations in wastewater treatment plant design
  - 179.1 Conducting operation and maintenance inspections at municipal wastewater treatment facilities
  - 179.2 Troubleshooting operation and maintenance problems in wastewater treatment plants
- Water quality control (surveillance and monitoring)
  - 143 Fish kill investigation technology
  - 161.1 Water quality and pollutant source monitoring: field and laboratory procedures
  - 161.2 Planning monitoring activities in water quality management programmes
- Water quality control (analytical series)
  - 100.4 Inorganic analyses in water quality control programmes
  - 100.5 Organic analyses in water quality control programmes
  - 103.1 Pesticide residue analysis in water
  - 107.1 Introduction to instrumental analysis of water pollutants
  - 107.4 Analytical methods for trace metals
  - 120.4 Bacteriological methods in water quality control programmes
  - 140.5 Benthic analyses
  - 141 Plankton and periphyton analyses
  - 141.1 Microbiology of activated sludge
  - 147.2 Water quality indicative organisms: caddis fly larvae
  - 149 Bioassay for toxic and hazardous materials
  - 151 Analytical quality control
  - 801 Basic environmental statistics

Water Supply
- Methods for monitoring drinking water quality
  - 301 Methods for determination of chemical contaminants in drinking water
  - 320 Methods for determination of bacteriological contaminants in drinking water

SURVEY OF TASMANIA'S WETLANDS

Dr Chris Harwood is currently carrying out a survey of Tasmania's wetlands to ascertain their conservation status. He is employed by the Tasmanian Conservation Trust which has received a grant for the project from the Australian Heritage Commission. Chris' address is c/o Department of Geography, University of Tasmania, G.P.O. Box 252C, Hobart, Tasmania 7001.

The principal aims of the project are:

(a) devising a classificatory scheme for Tasmania's wetlands and compiling an ecological inventory of the wetlands

(b) ascertaining the current conservation and management status of Tasmania's wetlands, and

(c) making recommendations on desirable steps to alter the current conservation and management status of Tasmania's wetlands.

The main procedures that Chris is using to realize the main aims are:

(i) the mapping of wetlands and determination of their status using aerial photographs and land tenure maps

(ii) the collection of field data on physical characteristics, vegetation and use of the wetlands; for this procedure Chris has produced a comprehensive survey questionnaire.

(iii) the development of an objective typology of wetlands using the physical and vegetation data

(iv) interviews and further field observation to determine the relationship between the developed typology and the bird habitats, uses and conservation problems of the wetlands

(v) assessment of the degree of conservation of the wetland types and of the best mode to achieve conservation of those poorly or not reserved

INTERNATIONAL CONFERENCE ON DEVELOPMENTS IN LAND METHODS OF WASTEWATER TREATMENT AND UTILISATION

This conference of the International Association on Water Pollution Research is being held at the University of Melbourne at the time of production of this issue of the newsletter (23-27 October). A perusal of the "Abstract of Papers" of the conference reveals a number of papers of interest to limnologists. Reflecting the biases of the editor the following titles are offered:

Environmental sources of heavy metals and their toxicity to man and animals - E.J. Underwood

Land treatment at Werribee: past, present and future - J.B. McPherson

/The effectiveness

(continued - paper titles)

The effectiveness of some crops in removing minerals from soils irrigated with sewage effluent - A. Feigin, H. Bielorai, J. Shalhevet, T. Kipnis and J. Dag

Cadmium uptake on organic and inorganic constituents of soil - I.H. Harding and T.W. Healy

The long-term effects of land application of wastewater - J.H. Reynolds, M.O. Braun, L.R. Anderson, R.W. Miller and W.F. Campbell

Ecological studies of lagoons at Werribee: removal of biochemical oxygen demand, nitrogen and heavy metals - S.U. Hussainy

The utilisation of waste nutrients for aquaculture - P. Tortell

Tertiary treatment with aquatic macrophytes - M.A. Simmonds

FORTHCOMING A.S.L. PUBLICATION ON AQUATIC RESEARCH IN SOUTHERN QUEENSLAND

A symposium on aquatic research in southern Queensland was held in Brisbane during September 1977. The papers of this conference have been edited by Professor W.D. Williams and have been approved for publication by the A.S.L. Publications Committee. Printing is now taking place and hopefully this A.S.L. Special Publication should be available shortly. Originally it was intended to issue the proceedings of the symposium as a newsletter but the poor reproduction of scanning electron micrographs by the Roneo or Gestetner duplicating process made this impracticable.

LIMNOLOGICAL VISITORS TO AUSTRALIA FROM CANADA

Professor H.B.N. Hynes and Mrs M. Hynes are currently working in Tasmania. They are spending most of their time in the bush collecting stoneflies. No doubt their efforts will result in a most substantial contribution to the taxonomy, zoogeography and biology of Australian stoneflies. In December they leave Tasmania to spend three months at the University of Adelaide.

Also visiting Australia from Canada is Professor K.H. Mann of the Department of Biology, Dalhousie University, Halifax. Professor Mann is now involved in research on productivity of inshore marine communities and is currently a Senior Queen's Fellow. After visiting the eastern states he is presently in Perth, W.A., working on the productivity of limestone reefs.

A.S.L./AUSTRALIAN HERITAGE COMMISSION INLAND WATERBODY SITES

As indicated in the last Newsletter, Ian Campbell eagerly awaits details of proposed sites from Queensland, South Australia and Western Australia.

CONFERENCES

AN INTERNATIONAL SYMPOSIUM ON ATHALASSIC (INLAND) SALT LAKES

First announcement and call for papers

A number of people met informally at the most recent SIL Congress (1977, Copenhagen) and discussed the proposal that an international symposium be convened concerned with the limnology of salt lakes. The proposal received support and was put before the International Committee and the Second General Assembly. It was endorsed by both bodies. This first announcement provides details of the venue, date, programme and other matters. Further details will be sent to those responding to this announcement.

Place:	Adelaide, South Australia, Australia
Venue:	University of Adelaide
Time:	Monday, 22 October to Friday, 26 October 1979
Organizing Chairman:	Professor W.D. Williams, Department of Zoology, University of Adelaide, Adelaide, South Australia 5001, Australia (from whom further details may be obtained)
Scope:	The symposium will include contributions on physical, chemical, biological and geological topics. However, the main thrust of the symposium is seen as being in the area of biology (ecological, physiological, regional studies, etc.); Estuarine papers will not be included except when the work reported relates in some way to inland salt waters.
Language:	English
Programme:	22-26 October 1979 - formal sessions 27-28 October 1979 - weekend field trip to saline lakes near Adelaide (salt work pans, salt lakes near mouth of Murray River) 29 October-2,3 November 1979 - alternative excursions (a) or (b) Excursion (a) is an excursion to coastal (but athalassic) salt lakes in south-east South Australia and athalassic lakes of volcanic plains west of Melbourne, Victoria. This excursion will be led by Dr I.A.E. Bayly, Department of Zoology, Monash University, Clayton, Victoria 3168, Australia, and will finish at Melbourne. Excursion (b) to Lake Eyre, Yorke Peninsula and Eyre Peninsula salt lake regions will be led by Professor W. D. Williams, Department of Zoology, University of Adelaide and will terminate in Adelaide.
Costs:	It is appreciated that the cost of a return air fare to Australia from Europe, North America (and almost anywhere!) will be high. In an effort to compensate, accommodation and subsistence costs in Australia will be kept to a minimum during the period of the symposium itself, and participants will camp on the excursions (mid-October in south-eastern Australia is usually reasonably warm and dry). No luxuries will be provided. Such registration

/and excursion

and excursion fees as may be charged will be minimal and cover only organisational and other costs. Negotiations are in progress with Qantas on the possibility of charter flights.

Publication: It is intended to publish the papers presented. However, all papers for publication will be subject to refereeing. The Dutch firm of Dr W. Junk have already indicated an interest in publishing proceedings of the symposium.

A second announcement with further details will be sent to all respondents to this announcement.

INTERNATIONAL CONFERENCE - HEAVY METALS IN THE ENVIRONMENT

A major International Conference on the Management and Control of Heavy Metals in the Environment will be held at Imperial College, London, U.K. from 18 to 21 September 1979.

The conference is being organised by an international committee under the chairmanship of Dr R. Perry of Imperial College, with the co-sponsorship of the Commission of the European Communities, the Institution of Public Health Engineers, the Institution of Water Engineers and Scientists and the World Health Organisation.

Themes for the conference will cover industrial and domestic waste treatment (including problems associated with sludge treatment and disposal), health effects related to heavy metal toxicity, advances in analytical techniques, sources and distribution of heavy metals in the environment, as well as an appraisal of the problems associated with the presence of heavy metals in their various forms.

Sessions will comprise invited papers outlining the international scene, and shorter, contributed papers, based on original research and case studies within the general themes outlined.

Invited papers will include those by Professor J. Paterson (Illinois Institute of Technology, U.S.A.) on industrial waste treatment, Professor M. Astruck (University of Pau, France) on metal forms and speciation, Dr D. Barltrop (St Mary's Hospital, U.K.) on health effects and toxicity, and Dr M. Berrow (Macaulay Institute, U.K.) on trace metals in soils.

Contributed papers will be welcome and intending authors should submit an abstract of 100-300 words to the secretariat in the first instance.

An exhibition will be held in conjunction with the conference, and organisations offering products and services in this field are invited to participate.

Further details may be obtained from the secretariat: CEP Consultants Limited, 14A Henderson Row, Edinburgh EH3 5DH, U.K. (Telephone 031-5572478) or from Dr R. Perry, Department of Public Health and Water Resource Engineering, Imperial College, London S.W.7, U.K. (Telephone 01-5895111, extension 1330) or Dr P. Barnes, School of Civil Engineering, University of New South Wales, Kensington 2033, N.S.W., Australia (Telephone 02-6623012 or 02-6623011).

ANZAAS

The 49th Congress will be held in New Zealand, 22-26 January 1979 at the University of Auckland. The congress theme is "Directions for the Future". Of interest to limnologists is the Intersectional Symposium (involving Zoology and Botany) on "Man's Impact on Inland Waters". This symposium has been convened by the New Zealand Limnological Society. In section 12 Botany there is a session on "Systematics and Ecology of Marine and Freshwater Algae", while in section 13 Agriculture and Forestry there is a session on "Agriculture, Forestry and the Maintenance of Water Quality". A new section, Trace Element Research, is offering an interesting series of papers on this subject.

FOURTH INTERNATIONAL SYMPOSIUM ON ENVIRONMENTAL BIOGEOCHEMISTRY

This conference to be held in Canberra from 26-31 August 1979 is being organised by the Australian Academy of Science. Its general theme is "Evolving Ecosystems". The main topics to be discussed are: early development of biochemical systems, development and maintenance of atmospheric oxygen and ozone, element transformation in the oxygenic environment, consequences of oxygen depletion, and agricultural and industrial practices and water quality.

For information, contact The Conference Secretary, Australian Academy of Science, P.O. Box 783, Canberra City, A.C.T. 2601, Australia.

INTERNATIONAL SYMPOSIUM ON WATER RE-USE

The American Water Works Association Research Foundation is organising an international water re-use symposium, to be held in Washington, D.C., from 25-29 March 1979. The theme will be "Water Re-use - from Research to Application". Subjects to be covered include pertinent case histories, water recycling research and practical community applications. Interested authors were invited to submit qualification information and a detailed 500-word abstract of their proposed papers by 15 September 1978 to: Conference Organising Committee, A.W.W.A. Research Foundation, 666 West Quincy Avenue, Denver, Colorado 80235, U.S.A.

SHORT NOTICES

1. Australian Society for Limnology - annual conference at Tallangatta, Victoria, on 18-21 May 1979.

2. International symposium - The Agricultural Industry and its Effects on Water Quality at Hamilton, New Zealand from 15-18 May 1979, organised by the New Zealand Committee for Water Pollution Research and the Royal Society of New Zealand. Details from Dr C.J. Schouten, Water and Soil Division, Ministry of Works and Development, Private Bag, Hamilton, New Zealand.

3. International symposium - Role of Water in Urban Ecology at Amsterdam, Holland, on 27-31 August 1979. Details from Mr K.C. Plaxton, Secretary, Organising Committee, P.O. Box 330, Amsterdam, Netherlands, and STOP PRESS:

4. Groundwater Pollution Conference, Perth, W.A., Aust. 29-23 February '79. Conference fee A$100.00; further information from Mr R.J. Hughes, AWRC Secretariat, Dept National Development, P.O. Box 5, Canberra, A.C.T. 2600, Australia

5. Freshwater Biological Association, Jubilee Symposium: The life in time of lakes ..... to be held at the University of Lancaster, England, 16-20 July 1979. Enquiries: Dr T.B. Bagenal, Windermere Lab., F B.A., Ambleside, Cumbria, LA22 oLP, England.

RESEARCH ACTIVITIES

Limnological research in north Queensland

A report from R.G. Pearson, Dept Zoology, James Cook University of North Queensland

It would appear that word has got around that not all biological studies in north Queensland need be taken with a pinch of salt. Whilst the draw of the Great Barrier Reef, consistently warm seas, attractiveness of the biota and the glamour attached to marine biology are recognised, it is a pity that there is not more interest in inland waters in the north Queensland area which certainly has its fair share of water and aquatic habitats.

The research projects are listed under the names of the principal workers. It will be seen that the topics are varied and some are only secondarily concerned with fresh waters - that is, many of the workers would not consider themselves limnologists.

Research in progress

Blair, Dr D. (tutor in zoology). The life cycles of schistosome species causing cercarial dermatitis of man in northern Australia. Completion date: December 1978. Funding: Clive and Vera Ramaciotti Foundations.

The most widespread schistosomes in north Queensland appear to be those inhabiting the nasal blood vessels of ducks and belonging to the genus Trichobilharzia. The cercariae of these cause dermatitis in man. Studies on the taxonomy and life cycle of the schistosomes are nearing completion.

The vector is the fresh water snail Lymnaea lessoni. Ecological studies are being undertaken to relate the snail life cycle with that of the schistosomes.

Collins, Mr J.D. (senior tutor in marine biology). Biology and behaviour of Pontomyia (Diptera:Chironomidae). Not a fresh water animal, but of interest to limnologists. This is a laboratory and field study of this little-known marine coastal chironomid.

Finlayson, Mr M. (Ph.D. student, Dept Botany; supervisor, Prof. D.J. J. Griffiths). Aspects of the hydrobiology of the Leichhardt River - Lake Moondarra Water Supply system, Mt Isa. Funding from WRFA and Mt Isa Mines Limited.

An intensive physico-chemical investigation has been carried out in order to characterise the lake and provide base-line data on its trophic state. The system is affected by sewage effluent from the municipal water treatment plant and is subject to a significant infestation of water weed. A pilot programme in which the water fern Salvinia molesta is tested for its ability to remove nutrients from the sewage effluent prior to discharge is currently underway. The effect of the mining complex, located upstream of the water supply system, has received special attention and the sampling programme has involved extensive monitoring of heavy metal concentrations in the water, in the sediments and in the tissues of various species of lake flora and fauna. The project is now in its third and final year.

/Fleay, Miss A.

Fleay, Miss A. (Honours student, Dept Zoology; supervisor: Dr R.G. Pearson). Studies on the feeding and behaviour of two species of cormorant. (Phalacrocorax sulcirostris and P. melanoleucos) on the Ross River Dam, Townsville. Completion date: November 1978.

Particular attention is being paid to the avoidance of niche overlap by the two species by reference to feeding and breeding strategies and associated behaviour.

Gillies, Mr J. (Honours student, Dept Zoology; supervisor: Dr N.E. Milward). A study of the occurrence, abundance, and aspects of the biology of fishes in Ross River Dam, Townsville. Completion date: November 1978.

Jones, Mr G.B. (Ph.D. student, Dept Marine Biology). Trace metal cycling in a tropical estuarine environment.

Kneipp, Mr I. (Ph.D. student, Dept Zoology; supervisors: Drs R.G. Pearson and J. Lucas). The ecology of Macrobrachium species (Decapoda:Palaemonidae) in a coastal stream in north Queensland. Completion date: December 1978.

Several species of Macrobrachium occur in the one stream. They differ in the degree of adaptation to the fresh water environment; these differences have been examined in field and laboratory studies.

Lucas, Dr J.S. (senior lecturer in zoology). Investigations of the genetic compatibility of populations of a fresh water crab, Halicarcinus lacustris, from different land masses in Australasia. Completion date: December 1979.

Milward, Dr N.E. (senior lecturer in zoology). Studies on the ecology and biology of fishes in north Queensland. (Continuing.)

Pearson, Dr R.G. and Mr L. Penridge (senior tutor and research officer, respectively, Dept Zoology). A study of the effects of sugar mill effluents on streams. Funding by member mills of the Sugar Research Institute, Mackay. Completion date: February 1979.

Several streams have been surveyed over a two-and-a-half year period to describe the normal flora and fauna of lowland streams and to assess the effects of mill effluents on these. Laboratory bioassays are in progress. The end product will be the correlations of particular communities with particular levels of water quality.

Pearson, Dr R.G. Studies on the macroinvertebrate fauna of island, rainforest and intermittent streams. (Continuing.)

Powell, Ms J.A. (tutor in botany). A study of the interaction between Brolgas and the sedge Dulkuru on the Townsville town common.

Taplin, Mr L.E. (Honours student, Dept Zoology; supervisor: Dr J.S. Lucas). Ion regulation of the fresh water crocodile, Crocodylus johnstoni. Completion date: November 1978.

The salinity tolerance of the fresh water crocodile, Crocodylus johnstoni, is being tested in the laboratory in acute and chronic experiments. Emphasis is on biological reality using outdoor enclosures with fed animals and on mechanisms of salt excretion using starved animals kept at constant temperature.

/Walker, Mr T.

Walker, Mr T. (Ph.D. student, Dept Botany). Processes contributing nutrients to the sea in the vicinity of Townsville.

As part of a study of the marine phytoplankton the input of nutrients from several rivers is being measured. Changes in nitrate, phosphate and silicate concentrations during the hydrological year have been measured in the Burdekin River and smaller coastal rivers in the vicinity of Townsville. Nutrient levels vary widely between water courses and are discharge-dependent.

Winsor, Mr L. (histologist). Survey of freshwater planarians, nemerteans and leeches in north Queensland. (Continuing.)

Theses

*Beumer, J. The fishes of a tropical river with emphasis on the spangled perch, Therapon unicolor Gunther, 1859, and the east Queensland rainbowfish, Nematocentris splendida Peters, 1866. (Ph.D. 1976. Supervisor: Dr N.E. Milward.)

*Glaister, J.P. The comparative postembryonic growth and development of two "varieties" of Caridina nilotica (Crustacea:Decapoda:Atyidae). (Honours 1973.)

*Mak, P. Aspects of the biology of an Indo-Australian teleost, Selenotoca multifasciata (Richardson 1844). (M.Sc. 1976. Supervisors: Drs N.E. Milward and C.G. Alexander.)

* With the exception of those marked with an asterisk, the address for correspondence to persons listed is School of Biological Sciences, Post Office, James Cook University, Queensland 4811, Australia.

ABSTRACTS OF THESES

The abstracts of two completed M.Sc. theses produced in the Department of Chemistry, Caulfield Institute of Technology are reproduced below. T. David Waite and S.H.R. Davies were supervised by Dr Barry Hart.

Chemical Forms of Trace Metals in some Victorian Waters

by S.H.R. Davies (thesis approved by Victorian Institute of Colleges, July 1978)

This thesis reports some initial investigations into the speciation of a number of selected trace metals (Cd, Cu, Pb, Fe and Zn) in Victorian inland waters.

The first stage of the study was the development and evaluation of several analytical procedures for the elucidation of the chemical forms of trace metals in natural waters. The methodology used involved the use of a combination of membrane filtration, ion exchange, dialysis and anodic stripping voltammetric techniques.

A number of Victorian inland waters were investigated, namely the Yarra and Acheron Rivers, Dandenong Creek, East Basin Lake, Lake Tarli Karng and Tarago Reservoir. The samples taken were analysed for trace metal composition and for a number of other chemical parameters such as pH, alkalinity, suspended solids, etc., the purpose of these latter analyses being to characterise the waters studied.

Multiple regression techniques were used in an attempt to relate the trace metal composition of the samples to the chemical characteristics of the waters studied. Because of the limited extent of the sampling, only tentative conclusions can be drawn from the data. The results do suggest however that the organic materials present in a number of the natural waters studied do play an important role in regulating the levels and distribution of copper, lead and zinc.

Some differences in the concentration and distribution of species of cadmium, iron and zinc between the estuarine and freshwater sections of the Yarra River were also noted.

In the Yarra River the concentration of labile (i.e. ion exchangeable or similar reactive form) lead and zinc was less variable than the concentration of the bound (total minus labile) forms of these metals.

Measurement of Organic Pollutants in Waters and Wastes

by T. David Waite (thesis approved by Victorian Institute of Colleges, July 1978)

Excessive concentrations of organic compounds in water represent a threat to the environment. Dissolved oxygen deficits, excessive growth, taste, odour and colour, and toxicity are some of the likely effects of organic pollution. A variety of tests are now being offered as useful indicators of the magnitude of organic contamination of waters. Despite the range of tests available, the standard five-day BOD test is still used by many pollution control authorities as the major indicator of organic pollution.

/Because

and

Because of the length of the BOD test/the difficulty in obtaining reproducible results many workers have attempted to correlate oxygen demand and organic carbon measurements and hence obtain BOD or COD results from the simpler and more reproducible TOC analyses. After an extensive review of existing correlation work it was concluded that even though no theoretical basis for correlation exists, linear relationships can be established between organic carbon and oxygen demand parameters for municipal and industrial wastes in cases where the overall variability of composition of the samples is small. It was pointed out however that even though TOC measurements may be used to estimate the BOD or COD in specific cases, the true potential of TOC analysis is not being realised when results are used in this way as TOC is a basic parameter in its own right.

A more detailed discussion of various analytical techniques for use in assessing the polluting potential of a waste has been facilitated by the partitioning of wastewater organics into biodegradable and non-biodegradable fractions. Insight into the complex mechanisms involved in the BOD process has made it clear that the BOD_5 test cannot adequately fulfil the varied demands made of it. A number of soundly based, informative tests have been suggested as possible replacements capable of fulfilling the classical BOD_5 test applications.

A more realistic method of assessing the assimilative capacity of a receiving stream has been discussed and "materials balance" and "mass culture" techniques have been suggested as possible ways of measuring the amount of biodegradable organics in a waste. The total bacterially available carbon test (T_bOD) appears promising. The advantages in using the rapid TOC technique rather than the BOD_5 test in assessing waste treatment plant performance have also been highlighted.

A number of techniques of use in estimating the magnitude of the non-biodegradable fraction of a waste have been reviewed. Parameters such as fluorescence intensity, carbon isotope ratios and the molecular weight distribution of organics in wastes would seem worthy of further investigation.

The results of a variety of experiments on the soluble organic content of untreated sewage wastes have clarified the roles that some of the suggested techniques might play in pollution control work. Substrate removal and oxygen uptake studies on three different raw sewage types indicated that substrate removal tests (the basis of T_bAC and T_bOD tests) are rather time-consuming and difficult to perform. Standardised procedures are necessary if acceptable reproducibility is to be achieved. Oxygen uptake studies by respirometric techniques are comparatively simple to perform and could be automated.

A basic point of contention with the classical BOD_5 test relates to the assumption that first-order kinetics are applicable for the duration of the test. Because of the widespread use of mathematical models of the oxygen uptake/substrate removal process in dissolved oxygen sag analysis and estimation of waste treatment plant loading, it is important that an accurate model be constructed. In this study a simple Monod expression has been satisfactorily fitted to the "first stage" of oxygen uptake (i.e. up to the BOD plateau). Excellent substrate removal curve fits have been obtained by using a Monod expression with an added term approximating predation and autodestruction. The possibility of parameter correlation highlighted the fact that care must be taken when using the least squares method to extract three or more parameters from data that describes a simple curve.

/As mentioned

As mentioned above, the fluorescence intensity of organics at certain wavelengths has been suggested as a measure of the size of the refractory organic component of a waste. Two other spectroscopic techniques - those of ultraviolet absorbance at 254 nm and ozone chemiluminescence - have also been suggested as indicators of organic pollution. The response of each of these spectroscopic techniques to a change in the biodegradable/refractory component ratio of a waste has been investigated.

The UV absorbance of a waste is indicative of the degree of that waste. A marked change in the UV absorbance/TOC ratio on degradation of a variety of sewage wastes emphasized the dangers involved in using UV absorbance at 254 nm as a simple measure of total organic content. The absorbance/TOC ratio should be obtained for each sample type studied.

The usefulness of fluorescence intensity as a non-specific measure of the amount of organics in a waste appears limited because of the dependence of emission intensity on the excitation wavelength used. Concentration quenching effects might also limit the usefulness of this technique.

The phenomenon of ozone chemiluminescence appears highly responsive to bacterial metabolites, biosynthetic intermediates and cellular constituents. Clearly, a place exists in pollution control work for this type of parameter, but much more work is needed to clarify the techniques and significance of ozone chemiluminescence.

As mentioned above, suggestions that a relation exists between the molecular weight distribution of organics in water and the magnitude of a recalcitrant fraction have been made. In an attempt to clarify this, ultra- and gel-filtration techniques were used to separate sewage organics into fractions above and below a molecular weight of 1000 before and after biodegradation. Difficulties were experienced in applying the technique of gel filtration to the complex mixture of organics, but the ultrafiltration technique appeared comparatively straightforward.

No distinctive relationships appear to exist between the molecular weight distribution of organics in wastewaters and the nature of the organics in the waste, but the observed increase in the proportion of molecules with molecular weight greater than 1000 following biodegradation has important implications in waste water treatment plant design. For example, if carbon adsorption treatment is to be used after the activated sludge process, a hydrolysis step should be included between biological treatment and adsorption. In this way the large molecules present can be broken down to smaller units which are more readily adsorbable and hence are removed by the carbon.

More importantly perhaps, ways of improving the efficiency of the activated sludge treatment process stem from an understanding of why the proportion of high molecular weight compounds present in the waste increases on biodegradation. It is postulated that these macromolecular secondary products accumulate because they are inaccessible to the endo-enzymes of the microbial cells. This access might be improved by the disruption of a portion of the cells within the waste, and the substrate removal capability of the medium might then be dramatically improved as a result.

In conclusion it should be stressed that no single way of "measuring" organic water pollution is adequate. A simple test, such as the TOC test, is ideally suited to monitoring programmes by which "baseline" levels of organic carbon content can be established and irregularities above baseline values detected, but once an abnormally high value is observed, further testing should be initiated in an attempt to establish the magnitude and nature of the offending material, and the polluting potential (oxygen demand, toxicity or whatever) of the waste.

A.S.L. BUSINESS

Minutes of A.S.L. Executive Committee Meeting held at Kinchega National Park, Menindee, N.S.W. on 22 May 1978

Present: I. Bayly (Chairman), J. Bell, J. Blythe, L. Buckmaster, I. Campbell, A. Fletcher, B. Harasymiw, B. Hart, P.S. Lake, L. Llewellyn, B. Mitchell, J. Powling

1. Adoption of agenda

2. Venue of 18th Congress

A number of possible sites were discussed, but it was decided that the executive had too little information on which to make a firm decision. The sites suggested were listed in provisional order of preference, and committee members designated to make further investigations as to facilities, availability, costs, etc.. The list was as follows:

Tallangatta (I. Bayly, S. Lake) Thompson River (J. Blythe)
Dartmouth (J. Powling) Albury-Wodonga

The Congress is to be held in May again, if possible.

3. Half-day symposium in 18th Congress

It was agreed in principle that a half-day symposium of invited papers would be held as part of the 18th Congress, with the topic to be decided when the venue is known, but before August 1978. The papers would be original, and may be published as a bulletin or special publication. B. Hart and J. Powling agreed to investigate possible topics and suggest possible speakers to the next executive meeting.

4. Publications sub-committee

As requested by the Annual General Meeting, a Publications sub-committee comprising P.S. Lake, I. Campbell and B. Harasymiw was established to fully examine the questions as to whether the Newsletter should be a publication, and the cost of reviving the Bulletin. B. Hart agreed to provide the sub-committee with the full correspondence from I. Bayly to the previous executive and the Newsletter editor.

5. Newsletter editor

P.S. Lake was elected.

6. Death of J. Lake

(a) I. Bayly agreed to write to Nola Lake to inform her of the Society's decision to confer the Jolly Award to John Lake.

(b) The committee felt it appropriate to make a commemorative gesture over and above the Jolly Award and it was agreed that this gesture should be one to the family rather than to the limnological community.

7. Budget for 17th Congress

B. Hart reported that the 17th Congress was running within its budget and that a small profit of about $400.00 was anticipated. L. Llewellyn was congratulated on his splendid organisation of the Congress.

/8.

8. 3rd special publication

I. Campbell agreed to write to David Thomas to obtain further information on his manuscript "A Key to the Diatoms of South Australia".

9. Education sub-committee

I. Campbell agreed to write to Ralph Grandeson suggesting that he proceed with the establishment of a sub-committee, and passing on the literature collected by J. Clarke.

10. World Wildlife Fund

J. Bell requested A.S.L. support for his application to the World Wildlife Fund for funds to carry out research on the Australian grayling. The committee agreed to support the application; I Campbell to write a letter of support.

11. Constitutional changes

D. Pollard is preparing a set of constitutional changes. It was agreed that J. Bell should obtain a copy of these and pass them on to I. Campbell for circulation to the members. It was also agreed that reference in the constitution to a publications account should probably be deleted, and that, if the Publications sub-committee could find no good reason for maintaining it, D. Pollard be requested to delete, along with the other changes, references to it.

12. Publications account

B. Hart's recommendation that the publications account be transferred to a higher interest deposit was accepted.

13. Filing cabinet

B. Hart's recommendation that the Society purchase a two- or three-drawer filing cabinet to store and transport the Society's files was accepted. I. Campbell agreed to undertake the purchase.

14. Minute book

I. Campbell agreed to buy and prepare a Minute Book for the Society.

15. Bulletins and special publications

The committee agreed that the bulletins and special publications of the Society should be collected at one place. One set of Bulletins and Newsletters is to be bound for A.S.L. records. Bulletins are to be offered for sale at $5.00 per set or $1.00 each.

16. A.S.L. library

Karl Shearer, the former librarian, has left Narrandera. J. Bell agreed to approach Stuart Rowlings and ask him to act in this capacity.

17. Jolly Award selection committee

I. Campbell agreed to search out all previous minutes relating to the composition of the Jolly Award Selection Committee and the nomination procedure and continuation of nominations for consideration at the next committee meeting.

/18.

18. National park use fee

L. Llewellyn informed the committee that a fee of $3.00 was payable to the National Parks Service for use of facilities for the 17th Congress. The Committee accepted his recommendation that a donation of $47.00 should also be made.

19. Letters

I. Campbell agreed, on behalf of the Society, to write to the Director of the N.S.W. National Parks Service and the Director of N.S.W. State Fisheries to thank them for their cooperation and that of their staffs for the 17th Congress.

20. Future meetings

The next meetings will be held on the following dates:

12 August and 17 November 1978.

I. Campbell
Secretary

BOOK REVIEWS

New Zealand Freshwater Fishes - a guide and natural history
R.M. McDowall 1978
Heinemann Educational Books (NZ) Ltd, Auckland; 230 pp.

Reviewed by D.A. Pollard

A reviewer could be forgiven for pointing out (on reading in the Preface to this book "For many years there has been a need for a volume on the freshwater fishes" of New Zealand) that there already exist two such books which deal with precisely that somewhat limited subject (those of Stokell 1955 and Woods 1963); and also for chiding the author for not at least mentioning them, whatever their failings, in his Preface or Introduction.

Bob McDowall's book, however, is by no means "just another fish book", and in my opinion more than justifies the claim made in the dust-jacket blurb that it "summarises all that is known about the fauna - native as well as introduced species" of New Zealand's fresh waters.

Although Heinemann's advance publicity handout for the book states that there are "about 27 native species and 50 in all" in New Zealand's freshwaters, 47 species, of which 33 are native, are dealt with in this book. The largest native fish family considered is the Galaxiidae (13 species - not five as stated in Heinemann's publicity handout), followed by the Eleotridae (6 species). The remaining nine native families considered contain only one or two freshwater species each, and of these five are predominantly marine

/fish

fish families containing species only occasionally entering freshwater. In addition to the very comprehensive species accounts there is an introductory chapter on the study and structure of fishes (which outlines the scope of the family and species accounts and provides basic information on scientific and common names and notes on observing, collecting, preserving and identifying fishes, as well as a key to the families and a comprehensive glossary), and general chapters on the fish and fisheries (including notes on Maori knowledge of and the history of the European discovery of the freshwater fish fauna, its present status in relation to environmental problems, and freshwater fisheries and fish culture), fish diseases and parasites, zoogeography (including notes on the relationships, derivation, life history and distribution patterns), and an epilogue entitled "What of the Future?". The reference section contains a very comprehensive (in fact virtually complete) bibliography of works on the New Zealand freshwater fish fauna.

In the introductory chapter a strong justification is made for the inclusion of detailed species accounts of the lamprey, several galaxiids, the smelts, the eels, some of the bullies, the black flounder and the torrentfish in this book, as it is pointed out that although "all are known to live in the sea during some period of their lives ..... they also live in fresh water for long periods, and in many instances are closely related to species that are entirely freshwater dwelling.". The inclusion of the yellowbelly flounder may also (only marginally) be justified on the latter grounds, but the inclusion of a detailed account of the kahawai Arripis trutta (known over here as the Australian salmon), which is a marine fish occasionally entering estuaries, is in my opinion quite unwarranted (in spite of the only, and most probably erroneous, 1886 record of it occurring in fresh water some 65 km upstream in the Waikato River). The inclusion of the stargazer (Leptoscopus) and the cockabully (Tripterygion), which (although they may occasionally be found in brackish upper estuarine habitats) are also true marine fishes, is also unwarranted. (And why use the outline of the black flounder - a most atypical and rather "marginal" freshwater inhabitant - as the dominant motif on the dust jacket? Surely a galaxiid would have been much more appropriate?) I would regard the inclusion of detailed accounts of the above three typically marine species as padding in a book of this nature - though they may warrant at least a mention in one of the general chapters. The otherwise small size of the New Zealand freshwater fish fauna is certainly no justification for their inclusion. With regard to the marine (and basically Australian) derivation of the indigenous fauna, this is discussed in some detail in the chapter on zoogeography.

One feature of the book which I found particularly pleasing was the attention drawn to the environmental problems, and particularly those related to habitat disruption and the effects of introduced species, facing the New Zealand freshwater fish fauna (particularly the galaxiids), both in the individual species accounts and the section on the present status of the fauna. With regard to the galaxiids it is pointed out that the Canterbury mudfish is now regarded as "endangered, and requires careful and urgent study", that the giant kokopu is now uncommon in many areas due to swamp drainage and competition with brown trout, that several of the other larger galaxiid species have suffered significantly from deforestation of stream banks, that the dwarf galaxias now only occurs in scattered pockets in its North Island range and has been excluded from many streams by brown trout, that the dwarf inanga has apparently been excluded from several lakes which it formerly occupied by rainbow trout, that the black and brown mudfishes have suffered from destruction of their habitat by swamp drainage, and that the inanga (the main commercial whitebait species), although it has survived heavy fishing pressure for over 100 years, is now much less common than it used to be in the North Island (probably due to swamp drainage and river modification). Doubt is also expressed as to whether the two eel species can stand present heavy commercial fishing pressures.

/With

With regard to introduced fish species and their effects on the native fish fauna it is interesting to note that almost a third of the species occurring in New Zealand freshwaters are exotic introductions (over a third if the basically "marine" species are excluded). In addition to the effects of trout on the several galaxiid species mentioned above*, it is noted that goldfish are now very widespread in New Zealand (though they have recently been declared a prohibited import), and that rudd have been illegally liberated "in dozens of farmers' ponds in the Auckland and Northland districts.". Mention is also made of Myers' (1965) paper pointing out the egg-and larvae-eating and "fin-nipping" habits of Gambusia (which is now fairly widespread in the northern part of the North Island) and attributed the extinction or serious reduction of several species of freshwater fishes in south-east Asia and Africa to this species, and the "stunting" as a result of overpopulation, and consequent lack of interest by anglers in English perch in New Zealand waters.

McDowall summarises the main environmental problems facing the New Zealand freshwater fish fauna as follows:

> "As European man has felled the forest and established pasture the rivers have become modified and less stable, the lakes have become more productive, and in some instances both rivers and lakes have become affected by extensive weed beds. Plankton blooms occur in some lakes. Many swamps have been drained, water tables have been lowered, and streams confined to shortened and straightened channels with steep to vertical banks often maintained by repeated draglining. Many rivers and streams have become polluted by industry, urban development, and probably equally important, effluents from large numbers of cowsheds. There is heavy exploitation of some species that have commercial importance. The faunas of New Zealand streams and lakes have been altered by the introduction of fish species alien to New Zealand. All these factors have had effects on the native fish fauna."

Many of the above problems seem only too familiar to those of us concerned with the environmental threats facing Australia's freshwater fishes and their habitats.ø

With regard to the New Zealand grayling, McDowall is incorrect in stating that "There is only one species of Grayling in New Zealand.". In fact there was only one species as it is now extinct (the last live specimen having been seen some 50 years ago). Although the cause of its extinction remains unexplained, he suggests that "a combination of the effects of the introduced trout and the deterioration of the freshwater environment were responsible for the decline and extinction of the Grayling.". Somewhat ironically he also notes that "complete protection" is now afforded this species! His account

/of the

---

* For accounts of the effects of trout on galaxiid populations in Australian fresh waters see Tilzey 1976 and Fletcher 1978.

ø Such problems in relation to the Australian scene are discussed in two chapters (Pollard, Llewellyn and Tilzey 1978, and Tilzey 1978) on freshwater fish and fisheries management and introduced fishes in a forthcoming book on the management of Australia's inland water resources.

of the grayling and its gradual decline from around the 1870s to its disappearance by about 1930 should be of particular interest to Australian freshwater ichthyologists in relation to the "seriously threatened" status of our own native grayling species (Lake 1971, Bishop and Bell 1978).

In addition to his thorough discussion of environmental problems I was also encouraged by the author's discussion of some of the currently applied management strategies outlined in the section on fisheries administration and policy. These, in addition to the banning of the further importation of goldfish and other coldwater species - including salmonids - due to the risks of disease introduction, include strict controls on the introduction of any fish species into waters in which they don't already occur, proposals for the creation of fauna reserves for endangered species (such as the Canterbury mudfish), and the formulation of a strict set of guidelines in relation to the further introduction of exotics (presently being applied to the proposed introduction of Chinese grass carp for aquatic weed control). Similar management strategies are either presently being applied or have been recommended (Pollard, Llewellyn and Tilzey 1978) in relation to these problems in Australia.

The layout of this book is very pleasing and the line drawings of fishes are typical of the excellent standard of draftsmanship found in McDowall's scientific papers (though I think they have suffered slightly from over-reduction); the many half-tone and 50 or so colour plates are average to middling in quality. I admire the author's attempt to illustrate as many species as possible with colour photographs of live fish, but more attention could have been paid to colour contrast and the selection of suitable backgrounds. Some of the half-tone photographs also seem superfluous (e.g. a highly magnified photograph is not really necessary to prove that eels do in fact have scales - Fig. 3.1, or an X-ray to prove that the grayling has two loops in its intestine - Fig. 5.3). Some of the habitat shots and some of those of fish parasites could also have been omitted, as could those of minute fish eggs on the wall of an aquarium (Fig. 6.32) and a rock (Fig. 17.4). May be these could have been more profitably replaced with more photographs illustrating the effects of habitat disruption (e.g. before-and-after photos of swamp drainage, etc.). The photograph of fisheries biologist A.M.R. Burnet (Fig. 1.9) standing in the middle of a swamp electrofishing in a collar and tie provides a nice touch in relation to the gentlemanly approach to piscatorial pursuits as practised in that most British outpost of the former Empire.

One line drawing that intrigued me was that first encountered on the title page of this book (and also reproduced on the publicity handout). A species, and may be even a family, that was certainly new to me; very like a smelt but without the adipose fin. I later found it again in the book, identified as a landlocked example of the common smelt Retropinna retropinna (Fig. 4.3), though I could find no mention in the text of this landlocked form lacking an adipose fin. If this was a mistake on the part of the blockmaker it was a most unfortunate choice of drawing to be given such prominence in this otherwise scientifically fastidious book. In fact, I could find remarkably few errors in the text (though a reviewer is expected to nit-pick at least a few to prove that he has actually read the book). The following is my contribution to this fine literary tradition: p. 37, Fig. 3.12 - shortfinned eel; p. 97, bottom right - Quinnat (salmon); p. 182, top left - Percalates novemaculeatus; p. 199, top right - Potamopyrgus. Also, is there a second lake called Rotoiti (p. 62, top right) in the North Island (one is shown in the South Island in Fig. 1.2)? and "aquatic bottom fauna animals" (p. 119, mid-right) is a bit clumsy.

/Finally,

Finally, in his epilogue McDowall states that "This brief chapter is a plea that those involved should remember that freshwater fishes inhabit the rivers and lakes of our countryside, and that they are a part of the unique natural heritage of New Zealand. There is an increasing awareness of this, but whether this awareness rests in the right minds is another matter.".

In short, this is a very fine book, and as stated in the publicity handout "will appeal as much to the intelligent layman cum fisherman as to the specialist academic.". However, in these hard economic times the recommended Australian retail price may mean that the average intelligent layman cum fisherman (not to mention the student) in this country will probably need to visit a library to consult it. The recommended retail price indicated on the New Zealand publicity handout was A$24.75, but that shown on the slip enclosed with the review copy was A$36.95. I rang Heinemann's Melbourne office to check whether or not this was a mistake, and they informed me the current Australian recommended retail price was now in fact $38.75! As the book is printed in Hong Kong (and not in New Zealand) this price can only be described as a blatant rip-off, and I suggest that those A.S.L. members who know the author personally and require a copy, write to him and ask him to obtain them one at the more reasonable New Zealand price.

References

Bishop K.A. and J.D. Bell (1978). Aspects of the biology of the Australian grayling Prototroctes maraena Günther (Pisces:Prototroctidae). Aust. J. Mar. Freshwat. Res. 29(6) (in press).

Fletcher A. (1978). The distribution of Salmo trutta and Galaxias olidus in some Victorian streams. Aust. Soc. Limnol. Newsl. 16(1):18-19.

Lake J.S. (1971). Freshwater Fishes and Rivers of Australia. Nelson, Melbourne, 61 pp.

Myers G.S. (1965). Gambusia - the fish destroyer. Trop. Fish Hobby 13(5):31-32, 53-54.

Pollard D.A., L.C. Llewellyn and R.D.J. Tilzey (1978). Management of freshwater fish and fisheries. In: An Ecological Basis for Water Resource Management (W.D. Williams, Ed.). A.N.U. Press, Canberra (in press).

Stokell G. (1955). Freshwater Fishes of New Zealand. Simpson and Williams, Christchurch, 145 pp.

Tilzey R.D.J. (1976). Observations on the interactions between indigenous Galaxiidae and introduced Salmonidae in the Lake Eucumbene catchment, New South Wales. Aust. J. Mar. Freshwat. Res. 27(4):551-564.

Tilzey R.D.J. (1978). Introduced fishes. In: An Ecological Basis for Water Resource Management (W.D. Williams, Ed.). A.N.U. Press, Canberra (in press).

Woods C.S. (1963). Introduced and Native Freshwater Fishes. Reed, Wellington, 64 pp.

Limnological Survey of the River Murray
in Relation to Albury-Wodonga, 1973-1976
by K.F. Walker and T.J. Billman, 1978
Albury-Wodonga Development Corporation and
Gutteridge, Haskins and Davey; 256 pp. Limited distribution.

Reviewed by P.S. Lake

It is a plain truth that the ecological investigation of Australian rivers has been greatly neglected. This fact is endorsed by a perusal of recent international reviews of river ecology (e.g. Hynes H.B.N. "The Ecology of Running Waters", Whitton B.A. (Ed.) "River Ecology"). Until now, and this trend may continue, Australian limnology has been primarily concerned with the investigation of lentic waters, in spite of the fact that on mainland Australia lotic waters constitute the principal natural limnological environment. The small amount of published limnological studies of Australian lotic waters are of three types; physico-chemical descriptions, studies of lotic fish, and brief ecological surveys of a few rivers. In the latter case most of the rivers investigated have been badly damaged by pollution - there is no published comprehensive ecological study of an undamaged Australian stream.

To the handful of Australian lotic studies a major contribution has now been added; the limnological survey of the Murray River written by K.F. Walker and T.J. Hillman. This report summarizes the data gained from an extensive study of the River Murray from Lake Hume to Lake Mulwala for the three years from 1974 to 1976.

With the State and Federal governmental decision to promote development of the cities of Albury and Wodonga, the farsighted decision was made to investigate the possible impact that development may have on the River Murray. The consequent investigations and this report are substantial and sound. The report should not be compared with what currently passes for an environmental impact statement in Australia. It differs most notably from environmental impact statements in that it makes a substantial contribution to Australian limnological knowledge. As the report shows, the investigations of the River Murray yielded extensive data from which valuable insights into the ecological structure and functioning of the upper River Murray were gained.

In brief the report covers a description of the physical nature of the section of river under investigation, the hydrology of the river, the water characteristics of the river including the stratification of Lake Hume and the movements of nitrogen and phosphorus, phytoplankton ecology, the trophic status of Lake Hume and Lake Mulwala in terms of potential for eutrophication, the levels of heavy metals and pesticides in the river and some brief faunal investigations. The faunal investigations include a survey of the fish of the billabongs and creeks, a survey of the zooplankton and a survey of the macroinvertebrates of the river and selected billabongs.

The report is clearly written and well organised in its presentation. It is well laid out with a most desirable outcome being that the numerous tables both in the main body of the report and in the appendices are easy to scan and interpret. In comparison with many environmental reports and recently published scientific books (especially symposium proceedings), this report is remarkably free of mistakes and printing errors. In Appendix 12.8, some of the macroinvertebrate families unfortunately end in "re".

/Major

Major points of limnological interest that emerge from the report include evidence of the very considerable impact that Lake Hume has on its downstream limnological environment, an indication of the impact that water management especially for irrigation has on the flow regime of the river and consequently the ecological effects of such management; a clear warning of the potential for eutrophication in the impoundments especially Lake Mulwala, a realization of the degraded state of the billabongs in the study area and an indication of current contamination of the river by some heavy metals and pesticides. The report firmly emphasizes the need for investigation of the River Murray to continue if wise development of the area is to occur.

The release of water from Lake Hume, especially in summer when the water comes from the hypolimnion, has a very marked influence downstream on such important environmental parameters as temperature, oxygen levels and nutrient levels (nitrogen and phosphorus). The dramatic alteration of the temperature regime of the river has undoubtedly had a most deleterious effect on native fish populations. The changes wrought on the limnological environment downstream of Lake Hume by the release of water from Lake Hume lends support to the case for a high level offtake on the Dartmouth dam for, as Walker and Hillman note, "the thermal effects of Dartmouth on the Mitta Mitta will, in the absence of controls, be at least as pronounced as the effects of Lake Hume on the Murray.". One wonders about the survival of native fish such as the rare Macquarie perch in the Mitta Mitta downstream from the Dartmouth dam. A hint of a multiplier effect is given in the report for the thermal effects of release from Dartmouth will possibly not only deleteriously affect the biota of the Mitta Mitta but "if summer releases from Dartmouth have a significant cooling effect on Lake Hume, one effect would be to render the Hume-Mulwala reach of the Murray even less favourable for many native fish.".

A problem of considerable interest raised in the report is the need in Australian limnology for us to gain a predictive understanding of the interactions between phytoplankton productivity, nutrient levels and turbidity. In Australia some lentic waters have nutrient levels which render them eligible for classification as eutrophic waters and yet because of the high turbidities of these waters, phytoplankton productivity is not on a eutrophic scale. This report documents some interesting field and experimental observations on this problem which have particular poignancy for the future trophic status of Lake Mulwala. This impoundment "is eutrophic with reference to nutrient criteria but fails to realize this potential in terms of biological activity.". Most probably if nutrient levels are unchecked and rise, the turbidity effect will be overridden. In the report considerable emphasis is given to the need to outline firmly the future nutrient inputs to the river from Albury-Wodonga that can be tolerated.

Of particular interest to me was the brief but effective account of the poor state of well-being of the billabongs along the river. The billabongs are now fixed in number as "new billabongs are unlikely to be formed under the present controlled flow regime.". Of this limited number only a few are more or less untouched - free from the damage of grazing, free from being effluent disposal receptacles. Introduced fish thrive in the billabongs with no doubt some deleterious effects on the invertebrates and native fish - and this stretch of the Murray has yet to be exposed to the attention of the European carp. A clear case emerges from the report for the conservation of "an ecologically significant sample of the existing billabongs.". Hopefully such conservation measures will be seen as an integral part of the development of Albury-Wodonga.

/The study

The study ends with a section called "Recommendations for Ongoing Studies" and a postscript. It is to be hoped that the recommendations for ongoing studies are adopted by the relevant authorities and that the data of this report are built upon in the future so that a clear, predictive knowledge of the River Murray becomes available to guide soundly the development of Albury-Wodonga. In Australia there have been no long-term published limnological studies of any particular system, and even though in recent years we have had a welter of environmental impact statements, there have been no published accounts of limnological investigations being carried out as development proceeds.

For those people and institutions interested in Australian limnology, this report would be an important if not an essential addition to their library. However, I gather that the report has a rather limited distribution. I, for one, would like to see the report widely distributed and I hope that the publishers can make arrangements to achieve such a goal. After all, the study is the only significant ecological survey of the River Murray - Australia's major river. The report is also the most comprehensive published ecological survey of any Australian river.

P.S.L.

Books noticed

1. Aquatic Weed Identification. Irrigation Services Division, State Rivers and Water Supply Commission, Melbourne, Victoria, 1978

2. Australian Freshwater Fishes. J.S. Lake, Thomas Nelson Aust. Pty Ltd, Melbourne, 1978.

3. Aquatic Weeds in Australian Inland Waters. D.S. Mitchell, Aust. Govt Publishing Service, Canberra, 1978.

4. River Plants: The Macrophytic Vegetation of Watercourses. S.M. Haslam, Cambridge Univ. Press, Cambridge & London, U.K. 1978. (See highly complimentary review by D.H.M. Spence in "Nature", vol. 275, p. 465.)

Bulletin of the Australian Society for Limnology

ANNOUNCEMENT OF PUBLICATION

Request for papers

The Executive Committee of A.S.L. has decided to revive publication of the Bulletin of the Australian Society for Limnology.

The Bulletin will publish refereed papers on subjects relating to Australian limnology. The requirements for intending authors to follow are identical with the 'Notice to Authors' of the C.S.I.R.O. journal "Australian Journal of Marine and Freshwater Research".

Papers for possible publication should be sent to:

Dr I.A.E. Bayly
Department of Zoology
Monash University
Clayton, Victoria 3168, Australia

An essay -

On the Conservation of Rivers in Australia

by P.S. Lake

By conservation I mean the management of natural man-influenced or man-made components of the environment such that their essential attributes and features are not degraded or destroyed. Effective conservation means adopting strategies of management to achieve this end; including the strategy of preservation. Preservation is continually maligned by developers either openly or through front organizations.

Management of components of the environment to allow exploitation of a particular resource as a commodity is regarded not as conservation but as resource husbandry. Husbanding a resource in a particular ecosystem to make use of that particular resource often means the intended degradation or destruction of other components of that system.

Australia is the world's driest inhabited continent and it is thus not surprising that the need for "water conservation" has provided powerful motivation for the creation of numerous artificial storages and river impoundment schemes. The urge to dam rivers seems to be an essential part of an Australian character, as essential a part as the urge to use water in a profligate, wasteful manner. "Water conservation" is resource husbandry for it deals with water as a commodity. Many natural and seminatural river ecosystems in Australia have been irreversibly damaged by dam construction and consequent impoundment.

Australia has a relative poverty of freshwater bodies and a great paucity of permanent lentic environments. Natural lentic environments are only well represented in Australia in Tasmania and in south-western Victoria. While in comparison with other continents, Australia has a paucity of flowing waters it is nevertheless true that flowing waters constitute by far the most widely distributed and common form of natural water body in Australia. The rivers of Australia, their form and irregular patterns of flow, their fauna and their flora are as distinctively Australian as marsupials or eucalypts. Yet both in terms of conservation and in terms of scientific research they have been neglected. If you look at the present system of national parks, state parks, faunal reserves, floral reserves, local reserves, sanctuaries, whatever you call areas that are set aside from present exploitation, you will see that (a) very few reserves have been established to conserve freshwater ecosystems - let alone rivers, (b) only very few reserves with water bodies have complete and intact river systems, and (c) the setting aside of an area as a reserve usually means conservation of the terrestrial components and little or no protection of the aquatic ecosystems. This applies particularly for rivers - for example consider the status of the Snowy, Geehi and Lumut Rivers in the Kosciusko National Park.

Rivers should be conserved, as other components of our natural environment should be conserved, because of a number of important values. I may point out here that to establish effective conservation of a river invariably means conservation of the catchment. The conservation values of rivers are many and can be put into the following categories:

1. Economic value - intact rivers have an immense array of economic values both directly and indirectly realised. Conserving an inland river with its flood plain and not drastically altering the flow regime will allow the breeding of many native fish,

/the

the regeneration of river red gums (important for timber), the breeding of many waterfowl, etc., all of which may have direct economic values. It should be realised that much of Australia's economically important freshwater biota inhabit lotic waters, e.g. most native fish, Murray crayfish. By conserving such a system with the swamps, its woodlands, the billabongs, its flora and its fauna, an area of considerable recreational value may be created. Such an area may have a high tourist value - an indirect economic value.

2. Scientific value - by conserving biota in natural ecosystems a rich store of genetic material is maintained for scientific study and possible future use. In ecological research overseas on problems such as nutrient movement, energetics and community metabolism, ecosystem stability and complexity, rivers have attracted considerable attention.

3. Educational value - the teaching of natural sciences especially ecology relies on first-hand experience of study material. Living lotic systems harbour a biota and ecological situations of considerable educational value.

4. Recreational value - the recreational value of rivers is considerable and is realised in a multitude of ways. Some such as painting or photography do not affect the river systems while others such as speedboat racing or water skiing are, in many localities, downright damaging to the river systems. In an ecological context in many localities they may be viewed as legalised vandalism.

5. Spiritual, enlivening and inspirational values - the contemplation of rivers is emotionally evocative for many people, pleasurably or painfully. The immense religious significance attached to rivers can be suggested by a recital of such names as Euphrates, Nile, Indus, Ganges, Jordan, Tiber ..... Rivers have inspired a wealth of writers - both novelists and poets. Even the Darling River has inspired poets, for example Henry Lawson wrote in the poem "Song of the Darling River":

> "The sky is brass, and the scrub-lands glare,
> death and ruin are everywhere;
> thrown high to bleach, or deep in the mud
> the bones lie buried by last year's flood
> and the demons dance from the Never Never
> to laugh at the rise of the Darling River."

Probably one of humanity's more painful celebrations of a river.

Some natural rivers being remote in natural surroundings may be wild rivers and may evoke feelings of wilderness. A Tasmanian conservationist Paul Smith has recently defined such values as "individually perceived values" and they include "freedom, challenge, romance, solitude, perception, inspiration and spontaneity".

6. Because rivers have always historically been the focus of settlement and movement by man, rivers in many instances have cultural or identity-enforcing values. The place of rivers

/in history

in history is a relatively unexamined question but there is no doubt that they are a very important cultural role - again a list may highlight this point - the Seine, the Thames, the Volga, the Rhine, the Danube, the Mississippi, the Yarra .....

Thus I hope that it is abundantly clear that the conservation of rivers and their catchments allows the realization of a number of important human values and that the conservation of rivers in Australia needs urgent and effective treatment.

The forces that have damaged or destroyed rivers, and continue so to do, in Australia are powerful and are many. They include:

(a) impoundment and dam construction
(b) river improvement and drainage works
(c) mining operation in rivers and on their catchments
(d) changes in catchment useage -- e.g. the disturbance of native vegetation
(e) pollution and eutrophication
(f) introduction, establishment and often governmentally-supported fostering of exotic biota
(g) exploitation of native biota

That such changes as the clearing of forested catchments damaged rivers was realised quite early in the history of man. The ancient Greek myth of Erysichthon spells out the dangers of being a deforester. Erysichthon was a wilful and impious man who, as a gesture of sheer defiance of the gods, cut down a grove that was sacred to Demeter, the Greek goddess of vegetation. His servants warned him of the danger, especially when blood began to gush from the wounded tree trunks and the nymphs within them cried aloud in pain. But the wilful man seized an axe himself and hacked at a great oak and brought it to the ground. Demeter in fury called upon Famine to avenge her; this hideous hag breathed herself into Erysichthon's body as he lay sleeping after his exertions and he awoke in a frenzy of hunger. His insatiable craving for food caused him to strip his whole Kingdom, dissipating the wealth his father had bequeathed him and leaving the land barren and its people destitute. When he had sold his own daughter into prostitution for food and was still starving, in the final extremity of famine:

> Most cursed caitiff as he was, with biting he did rend
> His flesh and by diminishing his body did intend
> To feed his body till that death did speed
> His fatal end. (Virgil)
> Metamorphoses

Hopefully such an ancient warning will curb the excesses of current denuders of Australia's forested catchments - be their purpose to mine bauxite or mine woodchips.

The rivers of Australia constitute a finite resource with the number of undamaged rivers steadily decreasing. There is a clear need to conserve effectively representative ecologically viable samples of Australian lotic ecosystems. Such a step even if it was accepted by the powers that be would be very difficult to implement now because our knowledge of Australian rivers upon which to base any system of ecological classification is very meagre.

/Limnological

Limnological research in Australia has been very lentic in its direction. A census of papers published in the last ten years in Australian Journal of Freshwater and Marine Research revealed 21 papers on rivers and their biota as opposed to 42 on lakes and their biota. Further, the best ecological knowledge of Australian rivers comes from the investigation of damaged rivers, e.g. Molonglo, Murray. There is no published comprehensive ecological study of an undamaged lotic system in Australia.

The lentic emphasis in Australian limnology flows over into the promotion of limnological conservation. In the list of Australian waters deemed worthy of conservation published in Project Aqua in 1971, not one river is included. The Committee of Inquiry into the National Estate in 1974, while recognising the distinctiveness of Australia's rivers and their biota and while deploring the damaging forces of pollution, catchment clearance, river improvement, etc., did not however see that rivers warranted any particular attention.

In the United States of America in recent times considerable steps have been made to conserve rivers. As can be applied elsewhere, the American recognition of the need to conserve rivers grew out of an increasing awareness of the diminution of undamaged rivers. As the stream ecologist K.W. Cummins states "Due to the activities of engineers in concert with power companies and agrenomists most of the large American rivers are now only a series of impoundments.".

In 1968 the U.S. Congress passed the National Wild and Scenic River System Act. The Act defined three types of rivers deemed worthy of conservation: "(1) wild river areas - those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America. (2) Senic river areas - those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by road. (3) Recreational river areas - those rivers or sections of rivers that are already accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.". In the 1968 Act nine river systems or parts of were immediately protected, and all or portions of 27 other rivers were mentioned specifically as being worthy of inclusion in the system if studies to be conducted by several Federal agencies showed their inclusion be feasible and justified. By 1977 seventeen rivers or major portion of rivers were protected in U.S.A. Both in Canada and New Zealand moves are afoot to conserve wild rivers - but in Australia the need to conserve wild and scenic rivers has scarcely been recognised let alone subjected to political debate. Rather we seem to be as determined as ever to develop the potential of our rivers - for impoundments or for the transport of pollutants.

I believe that there is an urgent need in Australia to identify, investigate and protect wild and scenic rivers. This applies particularly for the well watered, more highly populated parts of the eastern states. Each State should have its own system of protected, conserved rivers.

Without giving a list of rivers for possible protection, I would like to point out that in both Victoria and New South Wales very few untouched rivers remain. The uniquely Australian rivers of the inland plains have been poorly conserved and many have been very extensively impounded. In Victoria the lack of concern for river conservation is evidenced by the

/report

report of the Land Conservation Council on the most well-watered part of Victoria, the Alpine Study area. The report does not mention wild or scenic rivers or river conservation - it mentions fishing and canoeing as recreational activities to be catered for and devotes two complete chapters to water resources and water utilization (Resource husbandry of water).

In Tasmania some small rivers or parts of rivers are included in national parks. Of the major river systems many have been impounded by the Hydro-Electric Commission. This seemingly ceaseless process of impoundment now threatens a magnificently wild and glorious river - the Franklin. This river is a dramatically beautiful river and should be, in my opinion, conserved as an intact, untouched, wild river. I agree with the Tasmania Wilderness Society in their plea: "Don't Flood the Franklin".

SUSTAINING MEMBERSHIP

The Society acknowledges with gratitude the support of:

GUTTERIDGE, HASKINS & DAVEY

Consulting Engineers, Planners, Surveyors
380 Lonsdale Street, Melbourne, Vic. 3000

G. H & D is an established firm of consulting engineers, with a total staff of some 600 people, including planners, architects, surveyors, hydrologists and engineers. The firm has 17 permanent offices throughout Australia, and rightly claims to be one of our largest multi-disciplinary consulting organisations.

DEPARTMENT OF ZOOLOGY

University of Adelaide, G.P.O. Box 498,
Adelaide, S.A. 5001.